UNIT I HIGHWAY PLANNING AND ALLIGNMENT

PART – A

1. **List the different modes of transportation and their respective limitations. [N/D 2015]**

   The following are the four major modes of transportation:

   - Roadways or Highways for road transportation
   - Railways for rail transportation
   - Waterways for water transportation
   - Airways for air transportation

   Limitations

   - The limitations of road transport are that the rate of petroleum energy consumed is higher than for transportation by railways and waterways. The rate of emission of pollutants is also higher than the other modes of transport.
   - Water transportation is very slow, which is the greatest disadvantages of this modes. In fact this is the slowest among the four modes.
   - One of the limitation in air transportation is that the energy required and the overall operating expenses for air transportation are the highest in comparison to other modes. The operation of air transport is very much affected by weather condition such as severe storms and thick fog.

2. **List four parameters enumerated in traffic surveys for the alignment and design of highways. [N/D 2015]**
   - Traffic requirements
   - Traffic service level
   - Vehicle characteristics
   - Roads uses etc.,

3. Write short notes on Highway Research Board. [M/J 2016]

The Highway Research Board of the Indian Roads Congress was set up in 1973 with a view to give proper direction and guidance to the road research activities in India. The board is expected to act as national body for co-ordination and promotion of highway research.

The objectives of IRC Highway Research Board are to:

- Co-ordinate and conduct correlation services
- Collect and disseminate results of research.

4. What are Shoulders? [M/J 2016]

Shoulders are provided on both sides of the pavement all along the road in the case of undivided carriageway. Shoulders are provided along the outer edge of carriageway on the case of divided carriageway. The earth shoulders should have sufficient stability to support even a loaded truck and therefore they are constructed using good quality material. The minimum shoulder width recommended by the IRC is 2.5m.

5. Define central road fund. [N/D 2016]

- The Central Road Fund (CRF) was formed on 1st March 1929.
- At that period the consumers of petrol were charged an extra levy of 2.64 paisa per liter of petrol to build up the road development fund.
- 20 percent of the annual revenue is to be retained as a Central Reserve, from which grants are to be given by the Central Government for meeting expenses on the administration of road fund, road experiments and research on road and bridge projects of special importance.
- At present the revised cess collected on petrol and HSD towards CRF is @ Rs.2/- per liter.

6. **What are classified roads in Nagpur plan? [N/D 2016] [A / M 2017] [A/M 2019]**

   Write the classification of roads. [N/D 2017]

   i. National Highways (NH)
   ii. State Highways (SH)
   iii. District Roads:
      a. Major District Roads
      b. Other District Roads
   iv. Village Roads

7. **What are the recommendations of Jayakar Committee? [A/M 2017] [A/M 2018] [A/M 2019]**

   The most important recommendations made by committee are:

   - The road development in the country should be considered as a national interest as this has become beyond the capacity of provincial governments and local bodies.
   - An extra tax should be levied on petrol from the road users to develop a road development fund called 'Central Road Fund'.

8. **What are the objectives of Highway Planning? [N/D 2017] [A/M 2018]**

   The objects of highway planning are briefly given below:

   - To divide the overall plan into phases and to decide priorities.
   - To fix up date – wise priorities for development of each road link based on utility as the main criterion for phasing the road development programme.
   - To workout suitable financing system.

9. List out the Urban and Rural Classification of Highways. [N/D 2018]

The urban roads are classified as:

- Arterial roads
- Sub – arterial roads
- Collector streets and
- Local streets

10. Write any four limitations of highway mode towards sustainability. [N/D 2018]

- Access
- Health and Safety
- Individual Responsibility
- Land and Resource use

11. Write the functions of Indian Road Congress. [N/D 2019]

- At the instance of central government a semi – official technical body known as Indian Road Congress (IRC) was formed in 1934.
- It may recalled that this was one of the main recommendations made by Jayakar Committee.
- The Indian Road Congress was constituted to provide a forum for regular pooling of experience, technical knowledge and ideas on all matters related to the planning, construction and maintenance of roads in India.
- The IRC will prepare standard specifications and provide a platform for the expression of professional opinion on matters of relating to road engineering including those organization and administration.
- The IRC publishes journals, research publications, standards, specifications, guidelines and other special publications on various aspects of Highway Engineering.

PART – B

1. **List out all the types of Highways as classified in the Indian context starting from the Expressways upto Village / Rural Roads; for each type, briefly state its specifications. [N/D 2015]**

   Describe the classification of Highways based on location and functions. [A/M 2018]

   What are the various classification of roads? [A / M 2017]

Classification of Roads

Types of Roads

The roads are generally classified into two categories, depending on whether they can be used during different seasons of the year:

i. All – weather roads and
ii. Fair – weather roads

All weather roads

- All – weather roads are those which are negotiable during all seasons of the year, except at major river crossings where some interruption to traffic is permissible up to a certain extent, but the road pavement should be negotiable during all weathers.

Fair weather roads

- On 'fair weather roads' the traffic may be interrupted during monsoon season at causeways where streams may overflow across the road.

Based on type of carriage way or the road pavement, the roads classified as

i. Paved roads
ii. Unpaved roads

Paved roads

- The roads with a hard pavement surface on the carriageway are called 'paved roads'.

Unpaved roads

- The roads without hard pavement surface on the carriageway are called 'unpaved roads'.
- Earth roads and gravel roads may be called unpaved roads.

Based on the type of pavement surfacing provided, the roads may be classified as 'surface roads' and 'un-surfaced roads'.

Surface roads

- Road pavements with any type of bituminous surface or cement concrete are called surface roads.

Un – surfaced roads

- The roads which are not provided with a bituminous or cement concrete surfacing are called un – surfaced roads.

Methods of classification of roads

The roads are generally classified based on the following:

i. Traffic volume
ii. Load transported or tonnage
iii. Location and function

- Based on the traffic volume or flow, the roads are classified as heavy, medium and low volume roads. It is expressed as vehicles per day.
- Classification based on load or tonnage is also relative and the roads may be classified as class I, II etc., or class A, B, etc., and the limits may be expressed in terms of tonnes per day.

Road classification based on location and function

Road classification as per Nagpur Road Plan

The Nagpur road plan classified the roads in India based on location and function into following five categories and described below:

i. National Highways (NH)
ii. State Highways (SH)
iii. Major District Roads (MDR)
iv. Other District Roads (ODR)
v. Village Roads (VR)

National Highways (NH)

- National Highways (NH) are main highways running through the length and breadth of India, connecting major ports, foreign highways, capitals of large states and large industrial and tourist centers including roads required for strategic movements for the defense of India.
- They must give an uninterrupted road communication throughout the country and should connect the entire road network.
- The responsibilities of construction and maintenance of national highways was decided to be with the central government.
- All national highways are assigned the respective numbers. For example, NH – 44 is the longest running major north – south National Highway in India. It begins from Srinagar and terminates in Kanyakumari.

State Highways (SH)

- State Highways (SH) are arterial roads of a state, connecting the national highways of adjacent state, district headquarters and important cities.

- These highways are considered as main arteries of commerce by road within a state or similar geographical unit.
- The NH and SH have the same design speed and geometric design specification.

Major District Roads (MDR)

- Major District roads (MDR) are important roads within a district serving areas of production and markets and connecting with other major roads or main highways of a district.
- The MDR has lower speed and geometric design specifications than NH / SH.

Other District Roads (ODR)

- Other District Roads (ODR) are roads serving rural areas of production and providing them with outlet to market centers, taluk headquarters, block development headquarters or other main roads.
- These are lower design specification than MDR.

Village Roads (VR)

- Village Roads (VR) are roads connecting villages or groups of villages with each other to the nearest road of a higher category.

Modified road classification as per third 20 – year road development plan, 1981 – 2001

- The roads in the country are now classified in to three classes for the purpose of transport planning, functional identification, earmarking administrative jurisdiction and assigning priorities on a road network.
  i. Primary system
  ii. Secondary system
  iii. Tertiary system or rural roads

- Primary system consist of two categories of highways:
  i. Express ways
  ii. National Highways (NH)
- Expressways are a separate class of highways with superior facilities and design standards and are meant as through route having very high volume of traffic.
- The express ways are to be provided with divided carriageways, controlled access, grade separation at cross roads and fencing.
- These highways should permit only fast moving vehicles.
- Expressways may be owned by a central government or state government, depending on whether route is a National Highway or State Highway.
- The secondary system consist of two categories of roads
  i. State Highways (SH)
  ii. Major District roads (MDR)
- The tertiary systems are rural roads and those consist of two categories of roads:
  i. Other District Roads (ODR)
  ii. Village Roads (VR)

Classification of Urban Roads

- The road system within urban areas are classified as Urban Roads and will form a separate category of roads to be taken care by the respective urban authorities.
- The urban roads are classified as:
  i. Arterial roads
  ii. Sub – arterial roads
  iii. Collector streets
  iv. Local streets

2. List the effects on Environment and Ecology of the Surroundings due to a highway project. [N/D 2015]

- Road Ecology is the study of the ecological effects (both positive and negative) of roads and highways (public roads).
- These effects may include local effects, such as on noise, water pollution, habit destruction / disturbance and local air quality.
- The following are the five major categories of primary ecological effects on roads,
  i. Habitat loss
  ii. Disturbance
  iii. Corridor
  iv. Mortality
  v. Barrier

Habitat loss

- Construction of roads and railroads always implies a net loss of wildlife habitat.
- The physical encroachment on the land given rise to disturbance and barrier effects that contribute to the overall habitat fragmentation due to infrastructure.

Disturbance

- Roads, railroads and traffic disturb and pollute the physical, chemical and biological environment and consequently alter habitat suitability for many plant and animal species.

Corridor

- Road verges and road sides can however provide refuges, new habitats or serve as movement corridors for wildlife.

- These beneficial effects of infrastructure are a major challenge to planners and biologists, as management and design must be adapted to a wider landscape context.

Mortality

- Traffic causes the death of many animals that utilize verge habitats or try to cross the road or railroad.
- Traffic mortality has been growing constantly over the years, but is considered as a severe threat only in few species.
- Collision between vehicles and wildlife are also an important traffic safety issue.

Barrier

- For most non flying animals, infrastructure implies movement barriers that restrict the animals range, make habitats inaccessible and can finally lead to an isolation of populations.
- The barrier effect is the most prominent factor in the overall fragmentation caused by infrastructure.

Ecological Issues

Air quality

- Air pollution from fossil fuel powered vehicle can occur wherever vehicles are used.
- Emissions include particulate emissions from diesel engines, NO volatile organic compounds, carbon monoxide and various other hazardous air pollutants including benzene.
- Concentration of air pollutants and adverse respiratory health effects are greater near the road than at some distance away from the road.
- Road dust kicked up by vehicles may trigger allergic reactions.

Hydrology

- Urban runoff from roads and other impervious surfaces is a major source of water pollution.
- Rainwater and snowmelt running off from roads tends to pickup gasoline, motor oil, heavy metals, trash and other pollutants.
- Road runoff is a major source of nickel, copper, zinc, cadmium, lead and polycyclic aromatic hydrocarbons which are created as combustion byproducts of gasoline and other fossil fuels.

Noise

- Motor vehicle traffic on roads will generate noise, in a wide range of frequencies which can affect both humans and animals.
- The sounds made by motors, the wind over moving vehicles structures and the ultrasonic vibrations transmitted through the air and ground from vehicle passage can overlap with the frequency ranges and amplitudes used by animals for communication.

Mitigation Efforts

Awareness

- Awareness needs to be spread among drivers particularly those driving on forest road on maintaining speed limits and being vigilant.
- Environmental conservation group had initiated an awareness drive named PATH an acronym for Provide Animals safe Transit on Highways covering more than 17,000 km in India to highlight the importance of safe driving on forest roads.

Road permeability

- Wildlife crossing that allow animals to safely cross human made barrier such as roads, are intended not only to reduce road kill, but ideally to provide connectivity of habitat areas, combating habitat fragmentation.
- Wildlife crossing may include: underpass tunnels, viaducts and overpasses.

Recycling

- Materials removed from roads can reused in construction within the same project or in other locations.
- Road construction can also use waste material from other industries.
- Asphalt pavement is one of the most recycled materials in the United States.
- Common examples of waste products used in road building include coal fly ash (used to make concrete stronger), asphalt shingles and shredded tires (used in asphalt pavement), ground glass and steel mill slag (used as aggregate).

3. **For a highway alignment, to cross a river, what are the various Obligatory and other technical and economical consideration in aligning the highway across the river? [N/D 2015]**

Explain in detail the various factors affecting the design of highway locations. [N/D 2016]

Explain the requirement of ideal highway alignment and the factors controlling the alignment. [A/M 2018]

Elaborate the factors affecting the geometric design of highway. [N/D 2017]

Illustrate with neat sketches and explain, how obligatory points control a highway alignment. [N/D 2019]

Idea requirements of an ideal alignment

The basic requirements of an ideal alignment between two terminal stations are that it should be:

i. Short
ii. Easy
iii. Safe and
iv. Economical

Short: It is desirable to have a short (or shortest) alignment between two terminal stations.

Easy: The alignment should be such that it is easy to construct and maintain the road with minimum problems. Also the alignment should be easy for the operations of vehicles with easy gradients and curves.

Safe: The alignment should be safe enough for construction and maintenance from the view point of stability of natural hill slopes, embankment and cut slopes and foundation of embankments. Also it should be safe for the traffic operation with safe geometric feature.

Economical: The road alignment could be considered economical only if the total life cycle cost considering the initial cost and vehicle operation cost is lowest. All these factors should be given due consideration before working out the economics of each alignment.

Factors Controlling Alignment

The various factors which control the highway alignment in general are:

i. Obligatory points
ii. Traffic
iii. Geometric Design
iv. Economics
v. Other Considerations

Obligatory points

These are control points governing the alignment of highways. These control points may be divided broadly into two categories.

i. Points through which the alignment is to pass
ii. Points through which the alignment should not pass.

Points through which the alignment is to pass.

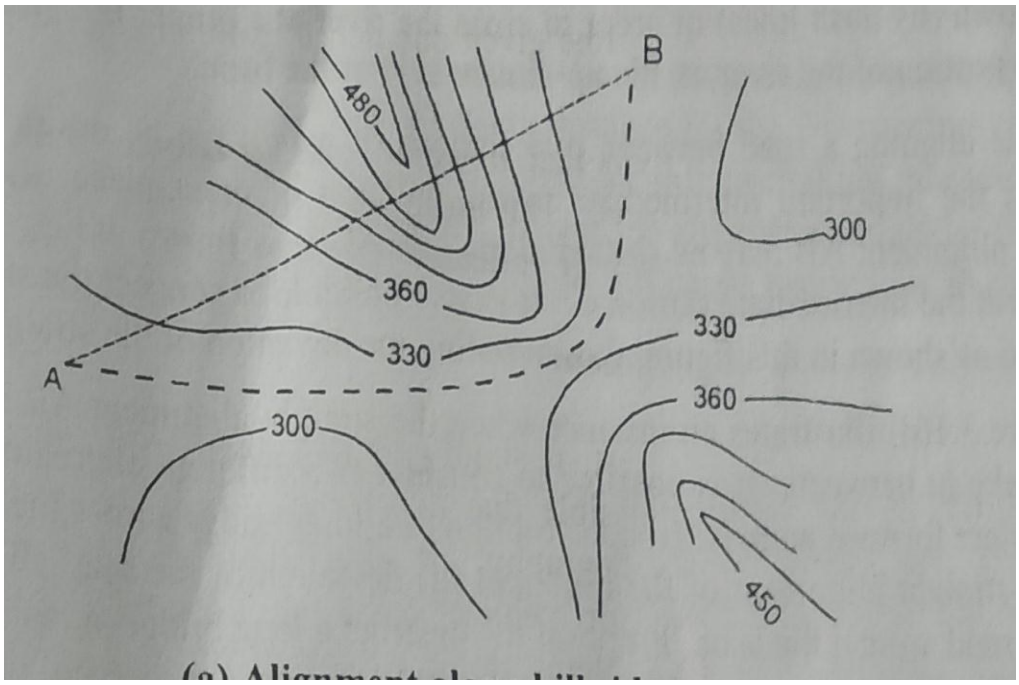
Obligatory points through which the road alignment has to pass are generally due to the topographic and other site conditions including natural obstructions.

Some of the examples of this category include location of mountain pass, suitable location of bridge to cross a river, presence of quarry or an

intermediate town to be connected. These obligatory points necessitate deviation of the road alignment from the straight alignment with shortest or easiest path.

Hill side pass

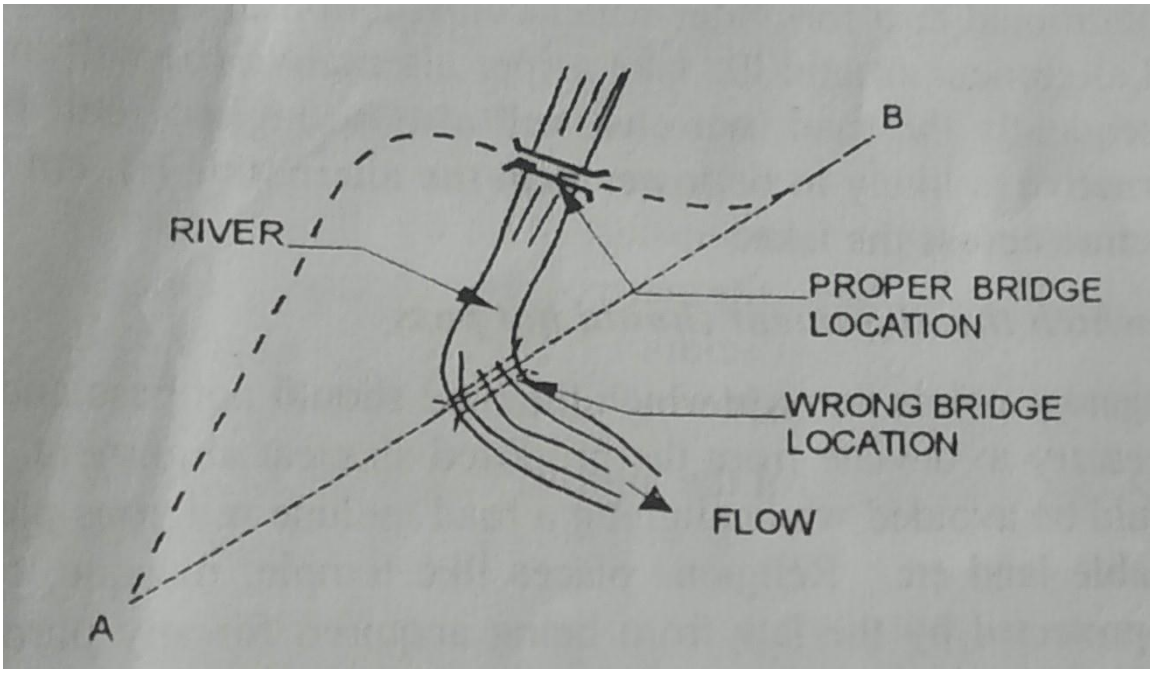
- When the road alignment has to cross hill range, mountains or high ridges, different alternatives to be considered are:
  i. To cut a tunnel across the hill or mountain
  ii. To go around the hill
  iii. To deviate until a suitable mountain pass is available.
- The choice or suitability of these alternatives depend on many other factors, like topography, site conditions and cost considerations.
- The below figure shows how the straight alignment AB is deviated along the hill pass, thus avoiding a tunnel or heavy cutting.



Alignment along Hill side pass

Bridge location

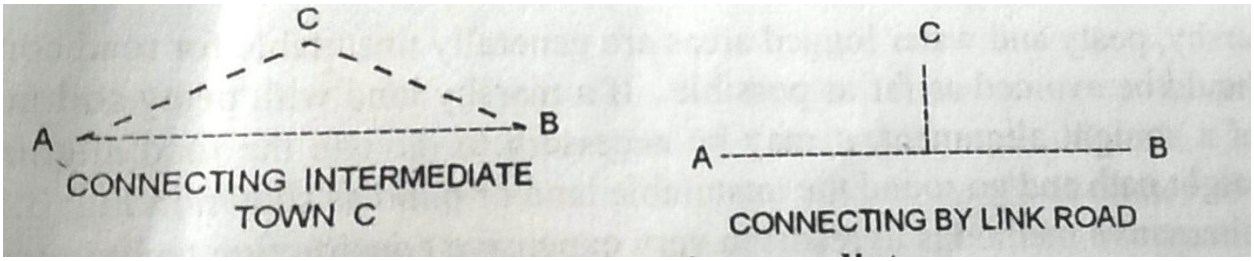
- The road bridge across a river can be located only at a place where the river has straight and permanent path and not where there is a bend in the river.
- The selected location of the bridge should be such that the abutment and pier can be properly constructed.
- The road approaches the bridge should not be curved near the bridge and as far as possible skew crossing of the river should be avoided.
- In order to locate a bridge across a river, the alignment may have to be changed.
- The following figures shows that the straight alignment between station A and B which crosses the river at the bend is not a suitable location and hence the alignment is to be deviated along the path shown by dash lines in order to cross the river at proper bridge location at the straight portion of the river.



Alignment to suit proper bridge location

Connecting Intermediate Town

- While aligning a road between two stations, it may often be desirable to connect some of the important intermediate towns, villages or other place of interest.
- The straight line AB may be shifted along line ACB, as shown in below fig. in order to connect the intermediate station C.
- It also possible to connect station C with a link road as shown in this figure, thus avoiding the deviation of the straight alignment.



Alignment to connect intermediate areas

Avoiding intermediate lake

- The below figures illustrate an instance when the straight alignment AB is encountered with a lake in between.
- It is possible to consider two different alternatives to take the road project forward namely,
  i. Construction of a long bridge across the lake along the original straight alignment of the road
  ii. Deviation of the road alignment and to take the road around the lake
- Proposal to construct a long bridge across the lake along the straight alignment as per alternative (i) will be very expensive and time consuming apart from additional cost for under – water construction of the bridge sub – structure.

- Taking the road alignment around the lakes as per alternative (ii) will increase the road length and consequently the road user cost will also be higher.
- But the total project cost of the alternative (ii) is likely to be lower than the alternative (i). So it is decided to align the road deviate from lake.

Alignment avoiding Intermediate area

Point through which the alignment should not pass

- There are obligatory points through which the road should not pass and these locations may make it necessary to deviate from the proposed shortest alignment.
- The obligatory points which should be avoided while aligning a road include religious places, very costly structures, unsuitable land etc.
- Religious places like temple, mosque, church, grave or tomb have been protected by the law from being acquired for any purpose.
- Acquiring costly structures would mean heavy compensation resulting in increased cost.
- Marshy, peaty and water logged areas are generally unsuitable for road construction and should be avoided as far as possible.

Traffic

- The road alignment should be decided based on the requirements of road traffic.
- Origin and Destination study should be carried out in the area and the desire lines be drawn showing the trend of traffic flow.
- The new road to be aligned should keep in view the desire lines, anticipated traffic flow, classified traffic volume, their growth and future trends.

Geometric Design

- Geometric design features such as gradient, radius of curve and sight distance also would be govern the final alignment of the highways.
- As far as possible while aligning a new road, the gradient should be flat and less than the ruling or design gradient.
- It may be necessary to change the alignment considering the design speed, maximum allowable super elevation and co – efficient of lateral friction.
- It may be necessary to make the adjustment in the horizontal alignment of roads keeping in view the minimum radius of curve and the transition curves.

Economics

- The alignment finalized based on the above factors should also be economical.
- While working out the economics, the factors to be considered are
    i. Initial construction cost of the road and bridge
    ii. Regular and periodic maintenance cost of the road
    iii. Vehicle operation cost in future.

Other Considerations

- Various other factors which may govern wither the horizontal or vertical alignment of the road and drainage considerations, hydrological factors, political considerations and monotony.
- The vertical alignment is often guided by drainage considerations.
- The sub surface water level, seepage flow and high flood level are the factors to be kept in view, while deciding the highway alignment.

4. **Compare the two modes of Transportation – Railways and Highways. [N/D 2015]**

Road Transportation

- Transportation by road system is the only mode which could give maximum flexibility of service from origin to destination, to one and all.
- Various classes of vehicles such as car, bus, truck, two – wheeler, etc., may be permitted to make use of the roads.
- Road transport mode has the maximum flexibility for travel with reference to choice of the route, direction, time and speed of travel.
- It is possible to provide door to door service only by road transport.
- The road network is essential to serve as feeder system for all other modes of transportation and also to supplement them.

Rail Transportation

- The concept of rail transportation is movement of multiple wagons or a train of wagons or passenger bogies fitted with steel wheels running over two parallel steel rails of the railway track.
- The full advantages of rail transportation should be taken for the transportation of bulk goods and passengers, especially for long distance on land routes and where the railway tracks are available.

- Rail transportation between the railway stations could be economical and advantages both for the passengers and also for transportation of goods on long haul distance.
- Different types of locomotives with steam or diesel engines or electric locomotives along the electrified railway tracks have been used in India.
- Indian railways has one of the World's largest railway network in the world.

5. Explain the Bombay Road congress 1961. [M/J 2016]

First and Second five year Plans (1951 – 1961) have faced several bottle necks in the road development sector. It was realized that a large portion of the plan is spent in activities other than actual construction.

Hence 20 – year road programme (1961 – 1981) was prepared by road wing of Government of India which has been adopted Chief Engineers. This is the Second 20 – year Road development plan and known as Mumbai Plan (1961 – 1981).

Following are the some of the salient features of the Mumbai Plan (1961 – 1981)

i. Rural areas should be provided with adequate communication.
ii. Attention to be diverted on semi – developed, under – developed and agricultural areas and due improvement has to be made.
iii. A road density of 32 km per 100 sq.km has to be achieved.
iv. Every developed village should be within 6.5km of metaled road.
v. Every uncultivated area village should be within 30 km of metaled road.

6. Explain in detail the reconnaissance survey for Highway location in rural areas. [M/J 2016] [A / M 2017]

The important objective of the reconnaissance survey is to examine the general characteristics of the area with a view, to select the possible alternative alignment.

The number of possible alternate routes may be worked out by using reconnaissance survey. This information may be useful while selecting the best possible route between two points. The information gathered from reconnaissance survey is grouped as traffic reconnaissance survey and engineering reconnaissance survey.

The various operations involved in this survey are,

i. Study of map
ii. Availability of resources
iii. Ground or Topological study

Study of Map

Study of map includes study of survey plans, contour maps, land use plans, stream and river basin maps, air photos, geological maps, climate records, etc.,

Availability of Resources

Availability of materials and man power, nearer to the alignment.

Ground or Topological study

In order to determine the physical features of the area and feasibility of different alternative routes, generally the reconnaissance survey is carried out for a new highway project. It is not required for the small works and works of minor relocation of an existing road.

The reconnaissance survey is the search phase of the highway route selection. The data collected in this survey are assembled through maps, pictures, reports and interviews and these are to be reviewed and reduced to meaningful proportions.

Following factors are to be considered in the reconnaissance survey.

i. *Area* – larger area is to be surveyed in the reconnaissance survey.
ii. *Assumption* – all assumptions are to be assumed to correlate with the true observations.
iii. *Existing Road* – a reconnaissance survey should not be guided by an existing road.
iv. *Revenue* – The expected income may be worked out in terms of overall development and population benefitted by the highway project.
v. *Survey Route* – Route for reconnaissance survey should be selected to cover maximum cities and should be free from high deviation.

7. Explain Jayakar Committee recommendations. [N/D 2016]

Jayakar Committee submitted its report by the year 1928. The most important recommendations made by the committee are:

i. The road development in the country should be considered as a national interest as this has become beyond the capacity of provincial governments and local bodies.
ii. An extra tax should be levied on petrol from the road users to develop a road development fund called 'Central Road Fund'.
iii. A semi – official technical body should be formed to pool technical know – how from various parts of the country and to act as an advisory body on various aspects of roads.

iv. A research organization should be instituted to carry out research and development work pertaining to roads and to be available for consultations.

Most of the recommendations of Jayakar Committee were accepted by the government and the major recommendations were implemented subsequently.

8. Explain the classification of urban roads with neat sketches. [N/D 2017]

Urban streets perform the following functions

- Mobility
- Accessibility
- Parking

Urban roads are classified based on the function and location as follows

- Arterial roads
- Sub – arterial roads
- Collector street
- Local street

Arterial roads

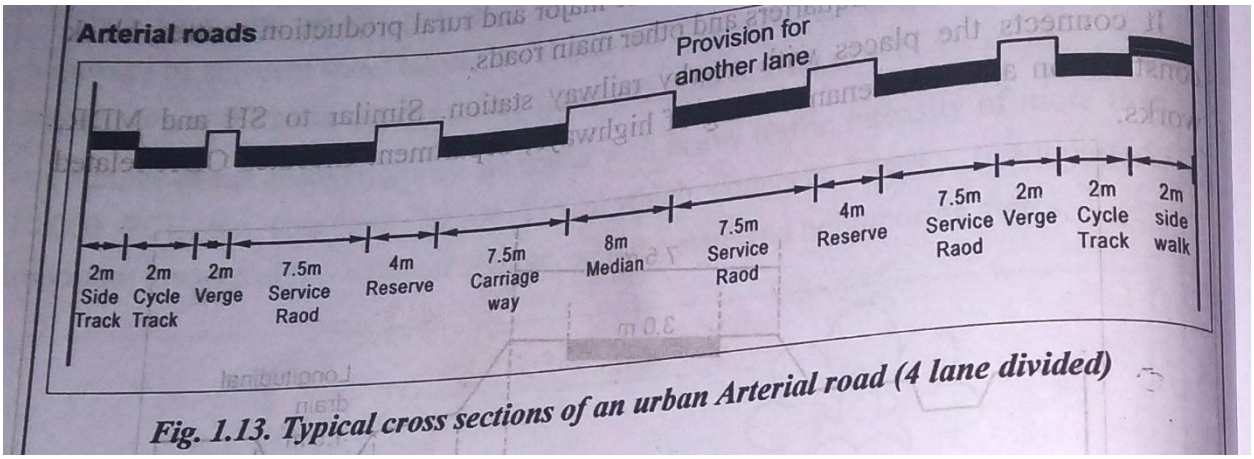


Fig. 1.13. Typical cross sections of an urban Arterial road (4 lane divided)

Sub – arterial roads

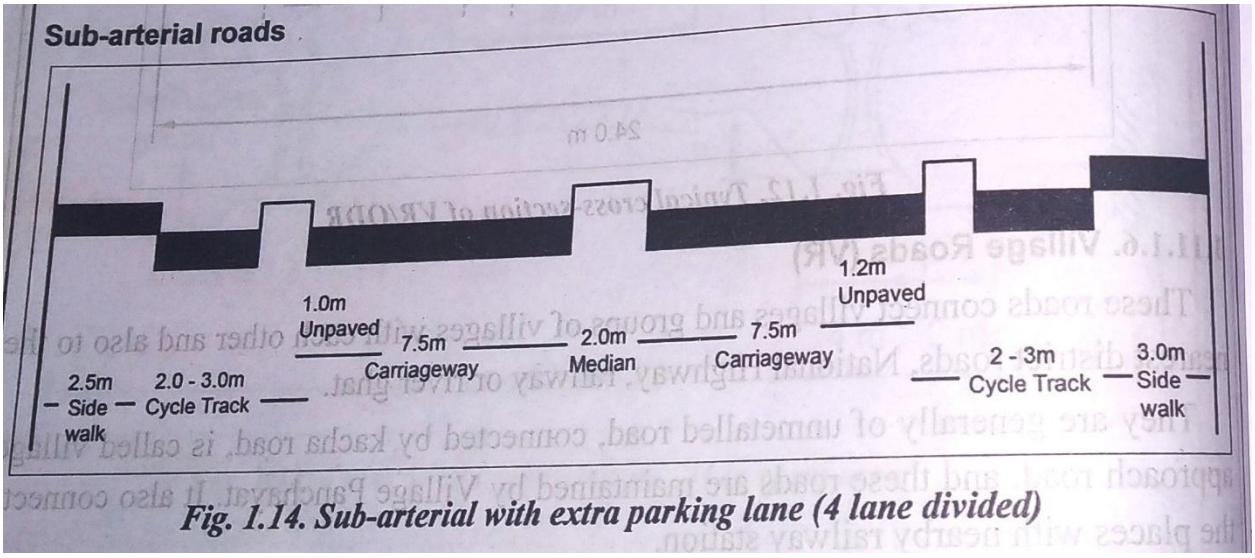
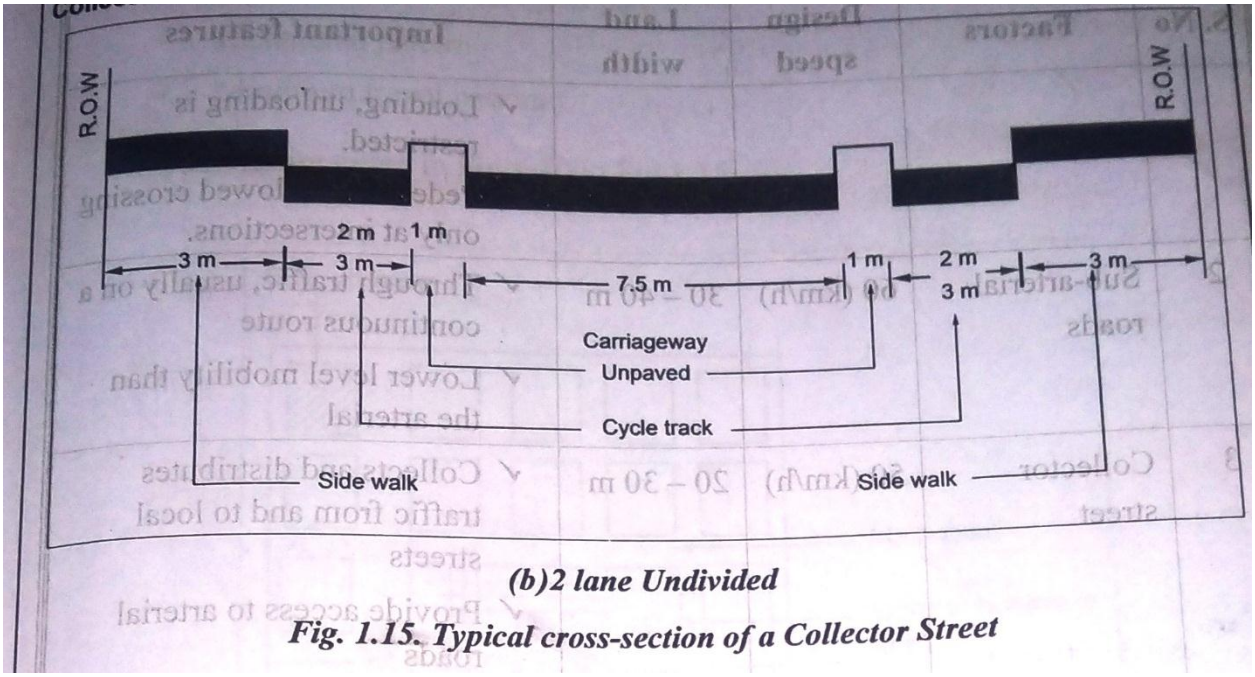


Fig. 1.14. Sub-arterial with extra parking lane (4 lane divided)

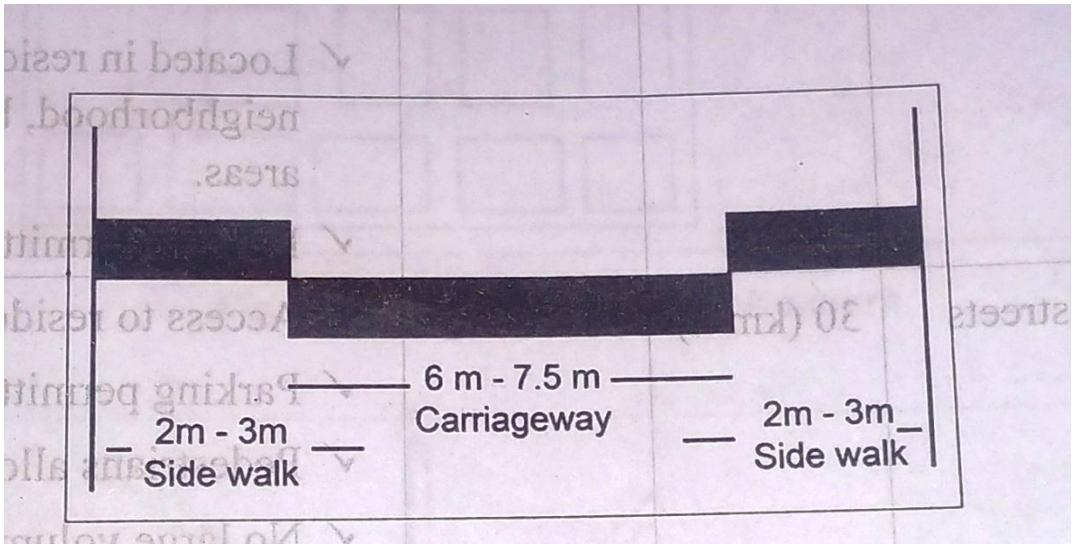
Collector Street



(b)2 lane Undivided

Fig. 1.15. Typical cross-section of a Collector Street

Local Street



The following tables shows the concepts of various urban roads

Sl.No	Factors	Design Speed	Land Width	Important Features
1	Arterial Roads	80 km / h	50 – 60m	➥ Through traffic usually on a continuous route ➥ Serve as the principal network ➥ Loading, unloading is restricted ➥ Pedestrians allowed crossing only at intersections.
2	Sub – arterial roads	60 km/h	30 – 40m	➥ Through traffic usually on a continuous route ➥ Lower level mobility than the arterial

3	Collector Street	50 km/h	20 – 30m	➥ Collects and distributes traffic from and to local streets ➥ Provide access to arterial roads ➥ Located in residential neighborhood, business areas ➥ Parking permitted
4	Local Street	30 km/h	10 – 20 m	➥ Access to residence ➥ Parking permitted ➥ Pedestrians allowed ➥ No large volume of traffic ➥ Most of the trips starts or ends on these streets.

9. Write short notes on

a. Indian Road Congress

b. Central Road Research Institute (CRRI)

c. Highway Research Board. [A/M 2018]

Indian Road Congress

- ➥ At the instance of central government a semi – official technical body known as Indian Road Congress (IRC) was formed in 1934.
- ➥ It may recalled that this was one of the main recommendations made by Jayakar Committee.
- ➥ The Indian Road Congress was constituted to provide a forum for regular pooling of experience, technical knowledge and ideas on all matters related to the planning, construction and maintenance of roads in India.

- The IRC will prepare standard specifications and provide a platform for the expression of professional opinion on matters of relating to road engineering including those organization and administration.
- The IRC publishes journals, research publications, standards, specifications, guidelines and other special publications on various aspects of Highway Engineering.

Central Road Research Institute (CRRI)

- In the year 1950, the Central Road Research Institute (CRRI) was started at New Delhi for carrying out research pertaining to road technology.
- It may indicated that one of the recommendations of Jayakar Committee report was to setup a central organization for research and dissemination of information.
- The CRRI is one of the national laboratories of the Council of Scientific and Industrial Research (CSIR).
- The institute is mainly engages in carrying out applied research in various aspects of highway engineering and offers technical advice to state governments and the industries on various problems concerning roads.

Highway Research Board

- The Highway research board of the Indian road congress was set up in 1973 with a view to give proper direction and guidance to road research activities in India.
- The board is expected to act as a national body for co – ordination and promotion of highway research.
- The Highway Research Board (HRB) has recommended suitable financial allocation of research by central and state governments and has chosen high priority research schemes for being taken up first.

- The objectives of IRC Highway Research Board are to
  i. Ascertain the nature and extent of research required
  ii. Correlate research information from various organizations in India and abroad with a view to exchange publications and information on roads.
  iii. Coordinate and conduct correlation services
  iv. Collect and disseminate results of research
  v. Channelize consultative service.

10. Write shortly the significance of 'Soil Suitability Analysis and Road Ecology' in highway planning [N/D 2018] [A/M 2019]

Soil Suitability

Pavements are a conglomeration of materials. These materials, their associated properties, and their interactions determine the properties of the resultant pavement.

Desirable Properties

The desirable properties of subgrade soil a highway material are:

- Stability
- Incompressibility
- Permanency of strength
- Minimum changes in volume and stability under adverse conditions of weather and ground water
- Good drainage
- Ease of compaction.

Tests on soil

The tests used to evaluate the strength properties of soils may be broadly divided into three groups:

- Shear tests
- Bearing tests
- Penetration tests

Road Ecology

Refer Question 2.

11. Write in brief the history of road development in India after independence. [N/D 2018] [A/M 2019]

After the independence the following road development was formed in India.

i. Central Road Research Institute
ii. National Highway Act
iii. Second Twenty Year Road Development Plan, 1961 – 1981
iv. Highway Research Board (HRB)
v. National transport Policy Committee
vi. Third twenty year road development plan, 1981 – 2001
vii. National Highways Development Projects
viii. Pradhan Mantri Gram Sadak Yojana (PMGSY)
ix. Road Development Plan: Vision 2021
x. Rural Road Development Plan : Vision 2025

Central Road Research Institute (CRRI)

- In the year 1950, the Central Road Research Institute (CRRI) was started at New Delhi for carrying out research pertaining to road technology.
- It may indicated that one of the recommendations of Jayakar Committee report was to setup a central organization for research and dissemination of information.

National Highway Act

- In 1956 the 'National Highway Act' was passed in the country. Some of the main features of the act include powers:

i. To declare certain highways as 'National Highways', responsibilities of development and maintenance of which to be with the central government.
ii. To enter into any land for carrying out surveys
iii. To acquire land and take possession for the development of the national highway.

Second Twenty Year road development plan, 1961 – 81

This is the Second 20 – year Road development plan and known as Mumbai Plan (1961 – 1981).

Following are the some of the salient features of the Mumbai Plan (1961 – 1981)

i. Rural areas should be provided with adequate communication.
ii. Attention to be diverted on semi – developed, under – developed and agricultural areas and due improvement has to be made.
iii. A road density of 32 km per 100 sq.km has to be achieved.
iv. Every developed village should be within 6.5km of metaled road.
v. Every uncultivated area village should be within 30 km of metaled road.

Highway Research Board

- The Highway research board of the Indian road congress was set up in 1973 with a view to give proper direction and guidance to road research activities in India.
- The board is expected to act as a national body for co – ordination and promotion of highway research.

National Transport Policy Committee

- The Government of India appointed the National Transport Policy Committee (NTPC) in the year 1978 to prepare a comprehensive

national transport policy for the country for the next decade or so, keeping in view the objectives and priorities set out in the five year plans.

Third Twenty Year Road Development Plan. 1981 - 2001

- The Third 20 – year road development plan 1981 – 2001 was prepared by the Road Wing of Ministry of Transport with the active co-operation from a number of organizations and experts in the field of Highway Engineering and Transportations.

National Highway Development Projects

- The National Highway Authority of India (NHAI) took up the National Highway Development Projects (NHDP) by the year 2000, in different phases.
- Phase I of NHDP is called the 'Golden Quadrilaterals' of total length 5846 km connecting the four major metropolitan cities.
- The four sides of the quadrilaterals are
    i. Delhi – Mumbai
    ii. Mumbai – Chennai
    iii. Chennai – Kolkata
    iv. Kolkata – Delhi
- Phase II of NHDP consist of
    i. North – South corridor connecting Srinagar – Kanyakumari
    ii. East – West corridor connecting Silchar to porbandar of total length 7300 km.